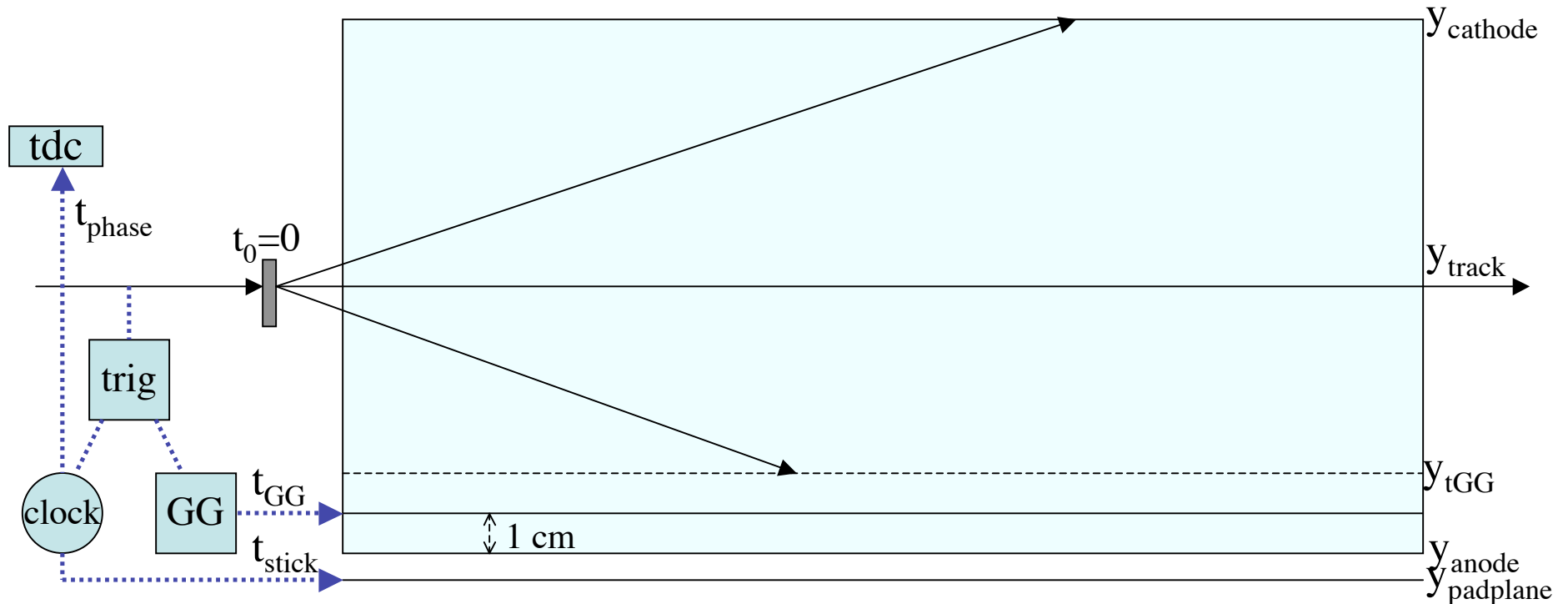
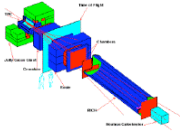


# TPC Timing Diagram

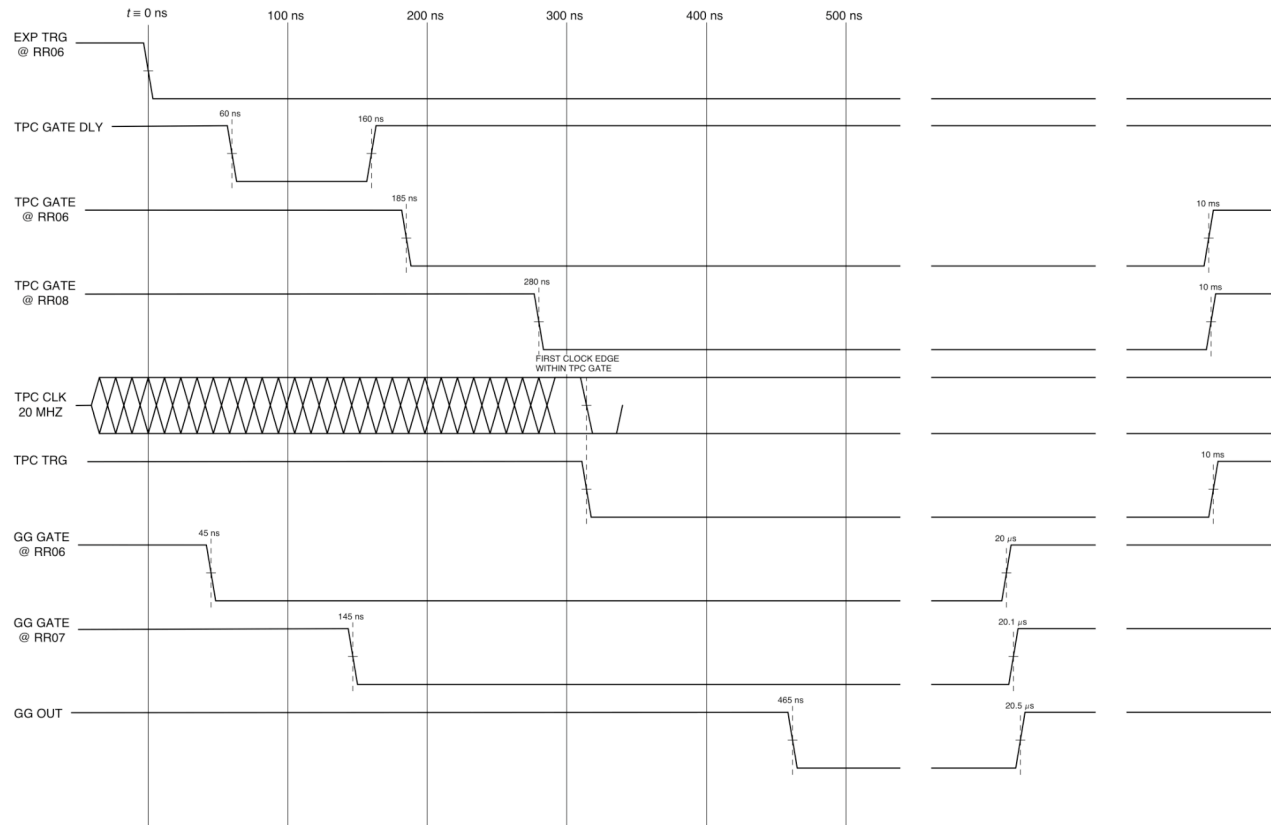


## • Timing Equations

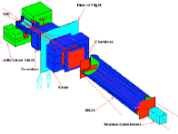
1.  $y_{\text{cathode}} - y_{\text{anode}} = v_{\text{drift}} (t_{\text{top}} + t_{\text{stick}}) = 74.8 \text{ cm}$
2.  $y_{\text{tGG}} - y_{\text{anode}} = v_{\text{drift}} (t_{\text{bottom}} + t_{\text{stick}}) = v_{\text{drift}} (t_{\text{GG}}) + 1 \text{ cm}$
3.  $y_{\text{track}} - y_{\text{anode}} = v_{\text{drift}} (t_{\text{track}} + t_{\text{stick}}) = \text{from DC matching}$



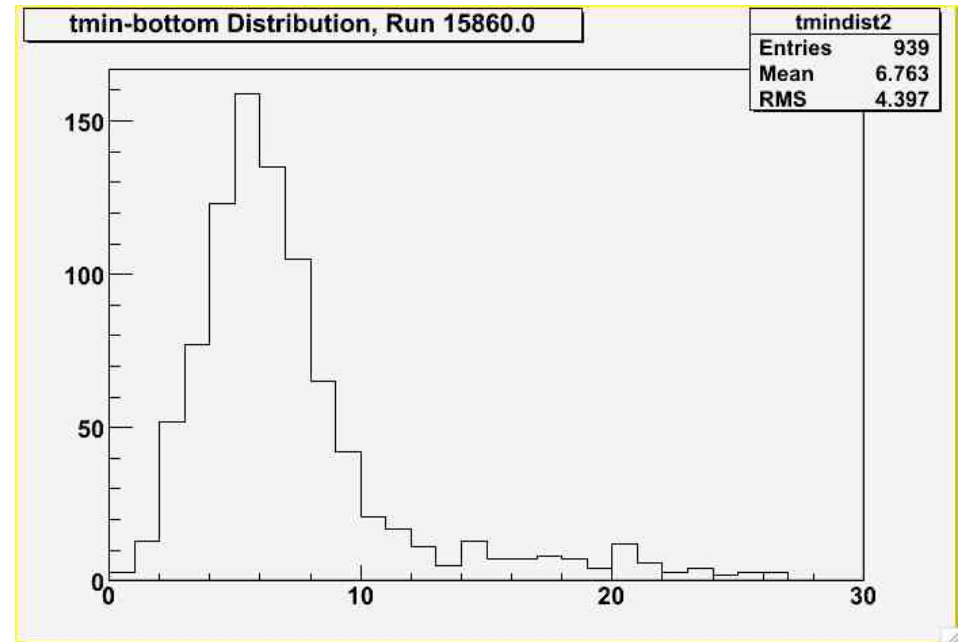
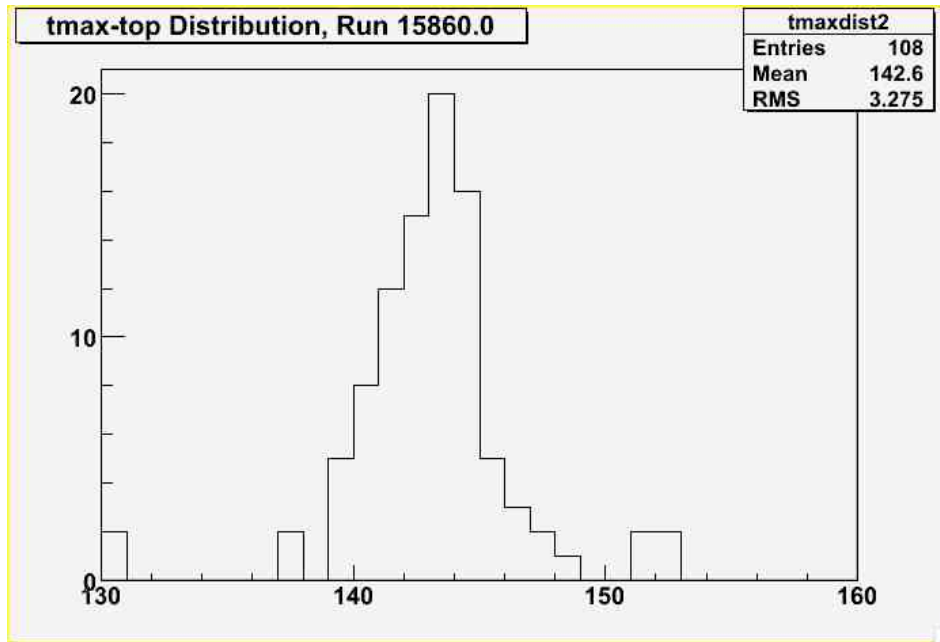
# Times we know to within 100 ns



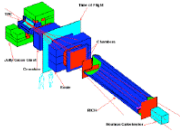
- $t_{\text{trig}} = 200 \text{ ns}$
- $t_{\text{stick}} = t_{\text{trig}} + 350 \text{ ns} = 5.5 \text{ bkt}$
- $t_{\text{GG}} = t_{\text{trig}} + 500 \text{ ns} = 7 \text{ bkt}$
- $t_{\text{phase}} = 450 \text{ ns}$  ( $\sim t_{\text{stick}} - t_{\text{trig}}$  with additional 100 ns delay)



## Times we can measure



- $t_{\text{top}} = 142.6$  bkt (units of 100 ns)
- $t_{\text{bottom}} = 6.7$  bkt
- $t_{\text{track}} = 12.7$  bkt below DC prediction



## Check the Math

- Timing Equations

1.  $y_{\text{cathode}} - y_{\text{anode}} = v_{\text{drift}} (t_{\text{top}} + t_{\text{stick}}) = 74.8 \text{ cm}$
2.  $y_{\text{tGG}} - y_{\text{anode}} = v_{\text{drift}} (t_{\text{bottom}} + t_{\text{stick}}) = v_{\text{drift}} (t_{\text{GG}}) + 1 \text{ cm}$
3.  $y_{\text{track}} - y_{\text{anode}} = v_{\text{drift}} (t_{\text{track}} + t_{\text{stick}}) = \text{from DC matching}$

- Divide by  $v_{\text{drift}}$  and compare LHS and RHS bkt

1.  $142.7 + 5.5 = 148.2 \text{ bkt}$   $149.6 \text{ bkt} = 74.8 \text{ cm}/v_{\text{drift}}$
2.  $6.7 + 5.5 = 12.2 \text{ bkt}$   $9 \text{ bkt} = 7 \text{ bkt} + 1 \text{ cm}/v_{\text{drift}}$   
 – gating grid taking ~300 ns longer to open?
3. Using  $t_{\text{phase}}$  instead of  $t_{\text{stick}}$  Jon finds tpc tracks low by 12.7 bkts.  
 There is no room to add this much time to  $t_{\text{stick}}$ . We should re-measure all times to be sure, but most likely the TPC (& JGG) are not where the software is placing them.